

Soil Presentation 2020



Map-Courtesy of Wikipedia

- Mesopotamia-once a region that supported agriculture using canal irrigation with water from the Tigris and Euphrates Rivers.
- 21,000 of the 35,000 square miles of alluvium of Mesopotamia may have been irrigated.
- Population of region at its peak 17 to 25 million people. (City of Babylon was located in this region.)

- Tigris and Euphrates Rivers are muddy- they transport a lot of silt, eroded from hillsides located far upstream.
- Some of the erosion was caused by overgrazing on the steep slopes in the upper watershed.



- Silt filled in the canals, which required a large labor force to clean out.
- Internal revolutions and foreign invaders interrupted the process of cleaning out the irrigation canals, which led to a decline in the agricultural productivity of the region.



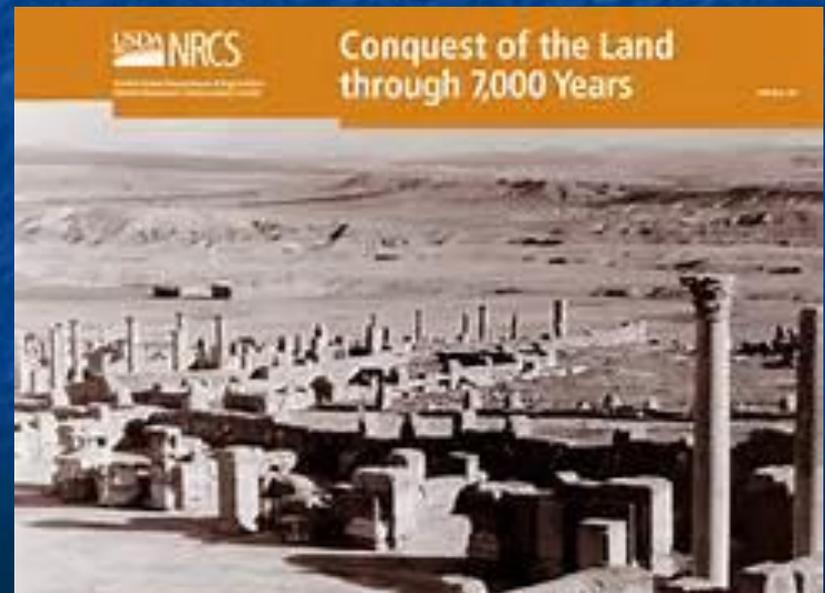
Irrigation canal, San Joaquin Valley, CA

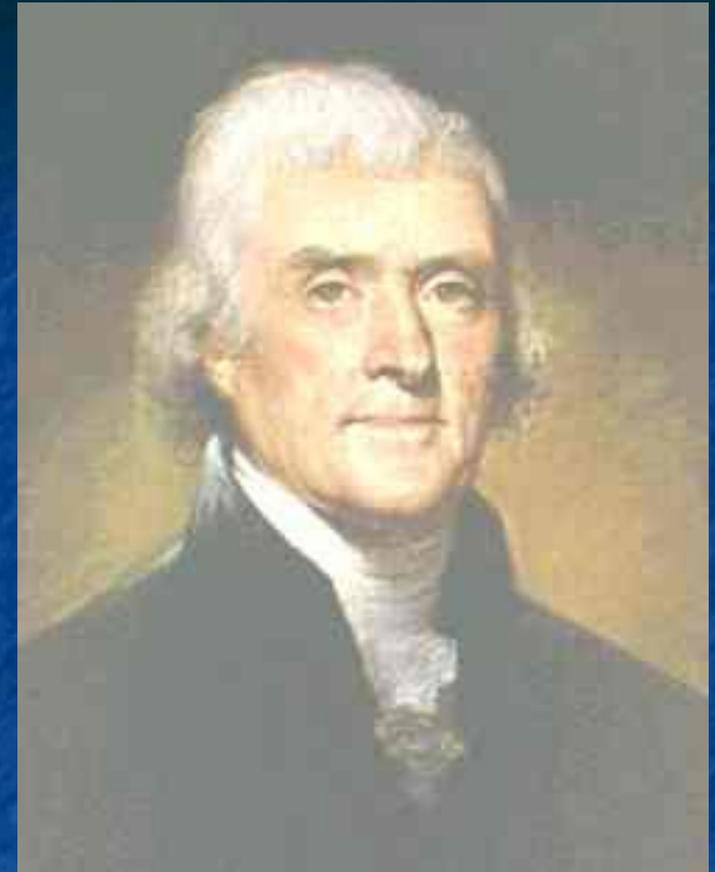
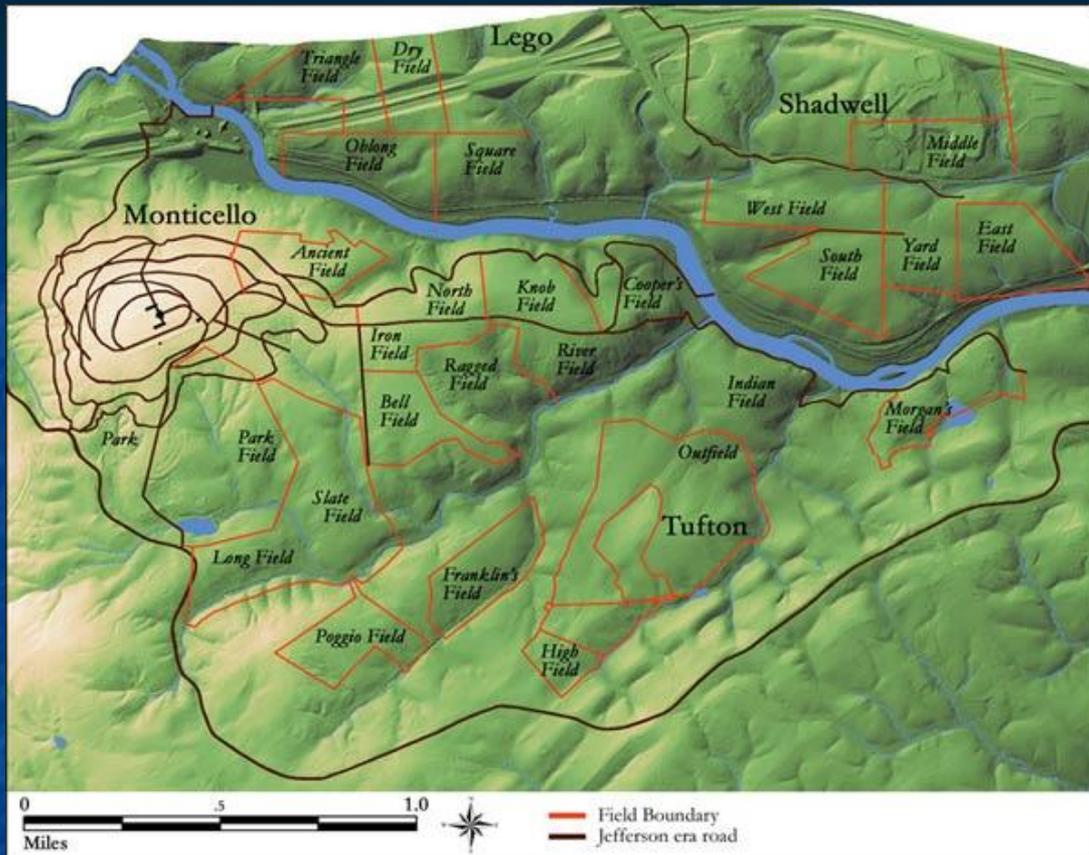
- Babylon died and was buried by the desert sands, in part because the irrigation canals that watered the land that supported the city were permitted to fill with silt.



Lesson Learned

- Agricultural practices, and particularly treatment of the soil resource, can have a major impact on the success or failure of a civilization.





"While the farmer holds the title to the land, actually it belongs to all the people because civilization itself rests upon the soil." - Thomas Jefferson



Soil erosion in Tanzania. (Carey Marks/Plymouth University)



Landslide-Pacific Coast Highway, CA (USGS)



Drought (CDC)



Sinkhole (USGS)



Dust Bowl (PBS)



Soils and U.S. Landscapes

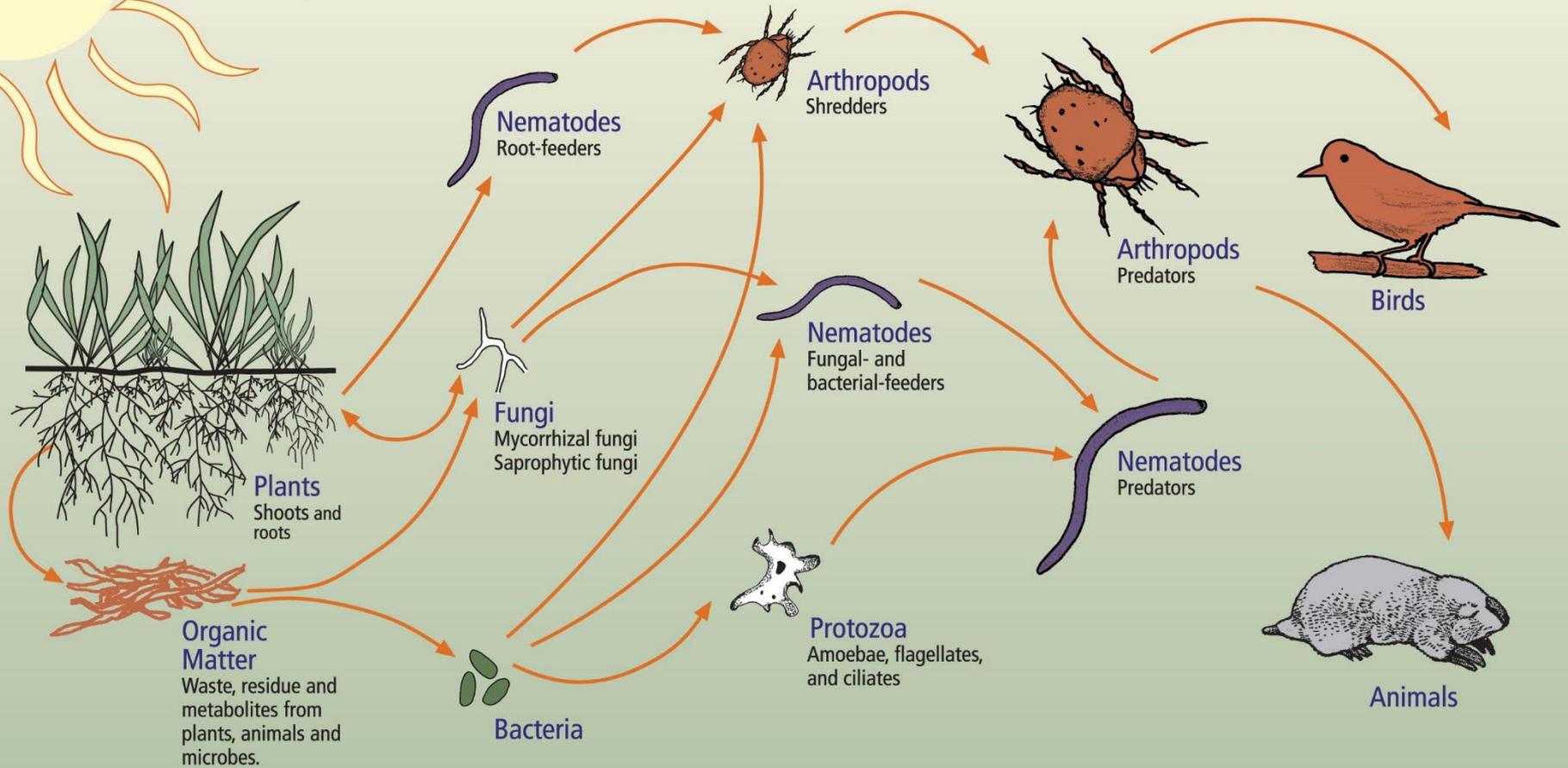


Ecosystem

“The interacting system of biologic community and its nonliving environment; a community together with its environment; an ecological system.”

Soils are part of an ecosystem. At the same time, soils are an ecosystem.

The Soil Food Web



First trophic level:
Photosynthesizers

Second trophic level:
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders

Third trophic level:
Shredders
Predators
Grazers

Fourth trophic level:
Higher level predators

Fifth and higher trophic levels:
Higher level predators

Chenango gravelly loam
Portland, New York



Soil- a natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthly parent material, as conditioned by relief over periods of time.

(From the Chautauqua County Soil Survey Glossary)

Soil-A Limited Resource



- ❖ 74% of the earth's surface is ocean
- ❖ Only 25% of the land area is arable soil

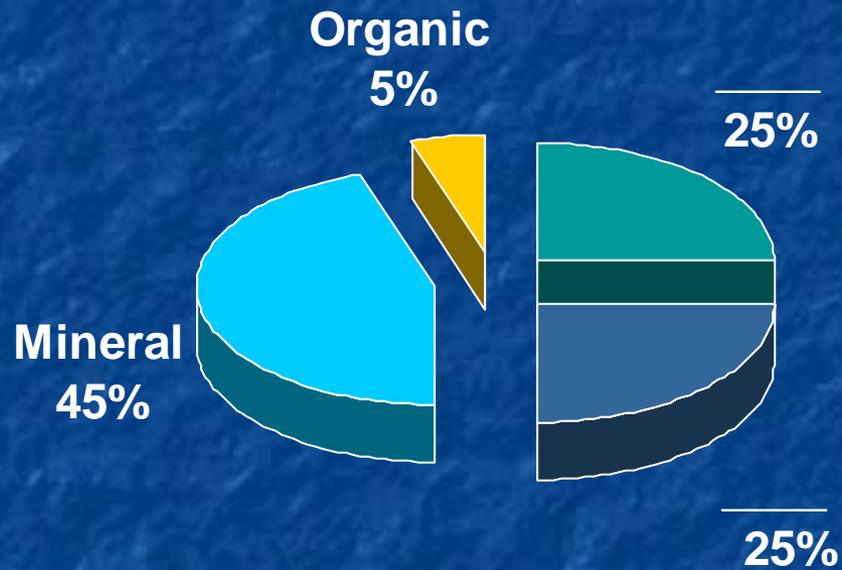
Soil Properties Vary

- Differences in soil properties result in differences in their capabilities & uses



Building on high shrink-swell clay

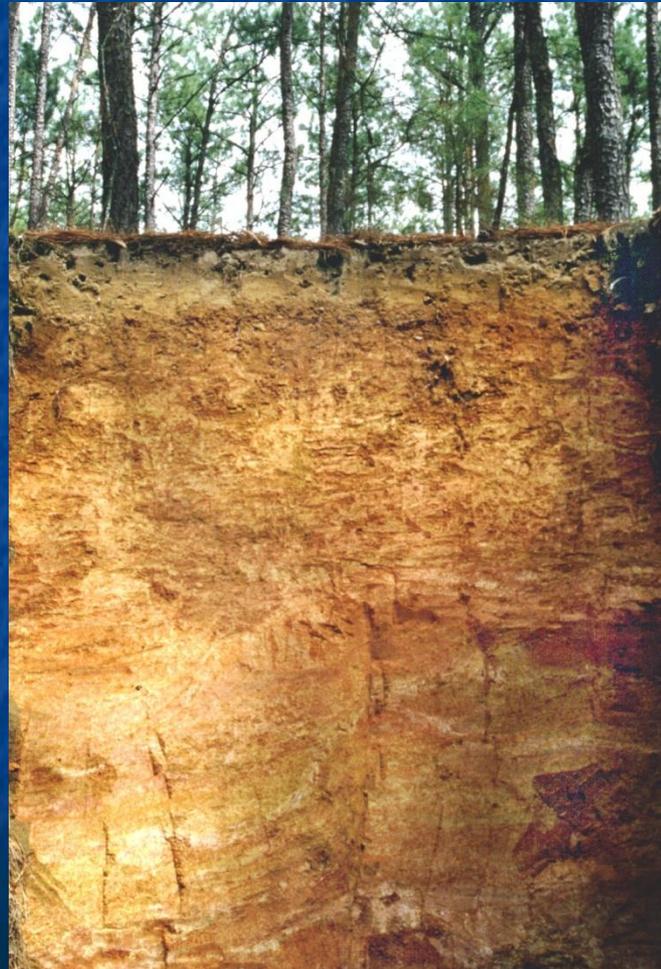
Soil Components



Soils are dynamic

Formation affected by:

- ❖ Parent material
- ❖ Climate
- ❖ Organisms
- ❖ Topography
- ❖ Time



Parent Material

Geologic



Biologic



Human Created



Parent Material-Geologic

- Alluvium: material deposited by-
-



Camp Creek
San Bernardino National Forest
California

Parent Material-Geologic

- Colluvium: material deposited at the base of steep slopes



Mt. San Antonio
Angeles National Forest
California

Parent Material-Geologic

Eolian Deposits: moved by- _____

Parent Material-Geologic

- Glacial Till: unsorted, nonstratified material deposited by glacial _____



Parent Material-Geologic

- Glaciofluvial deposits: moved by glaciers, then sorted & deposited by melting ice.

(Examples-kames, eskers, deltas, outwash plains)

ESKER



Other Geologic Parent Materials

- Deltaic and Beach Deposits
- Lacustrine and Marine Sediments
- Volcanic Deposits



Biologic Parent Materials

- Muck soils: primarily organic matter (decayed and decaying _____ and _____)



Human Created Parent Materials

- Brownfields, fill, excavated areas, or landfills



Chautauqua County Landfill
Town of Ellery, New York

Soil Formation: Climate

- Which region has a faster rate of soil development?
- *(Rainfall quantities and temperature affect rate of soil development)*

Amazon Basin



Gobi Desert



Soil Formation: Organisms

- accumulate and cycle organic matter, make soils more porous
- Macroorganisms: plant roots, burrowing animals



- Microorganisms: fungi, bacteria, nematodes, etc.



Soil Formation: Topography

- Water movement-erosion/deposition
- Aspect-temperature



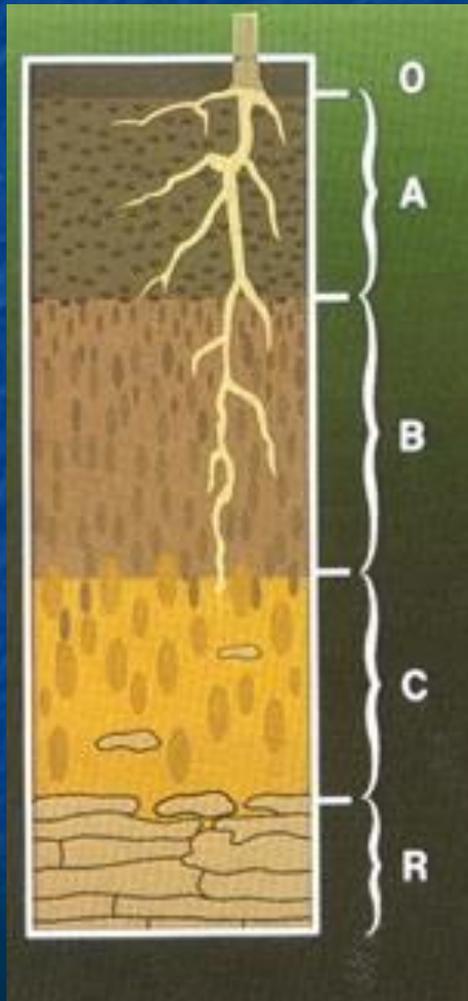
Soil Formation: Time

- Similar to a chemical reaction: *longer reaction time, greater change*
- 1-3cm soil takes 100 years to form in some situations

Mosses, Lichens, Organic Matter
Allegheny National Forest, Pennsylvania



Soil Profile:



- Horizons=horizontal layers
- “O”=organic
- “A”=mixture of organic & mineral soil
- “B”=accumulation of organic matter & sesquioxides (i.e. alumina)
- “C”=unconsolidated, unweathered material
- “R”=rock (not always present in the soil profile, i.e. flood plains)

Soil Characteristics

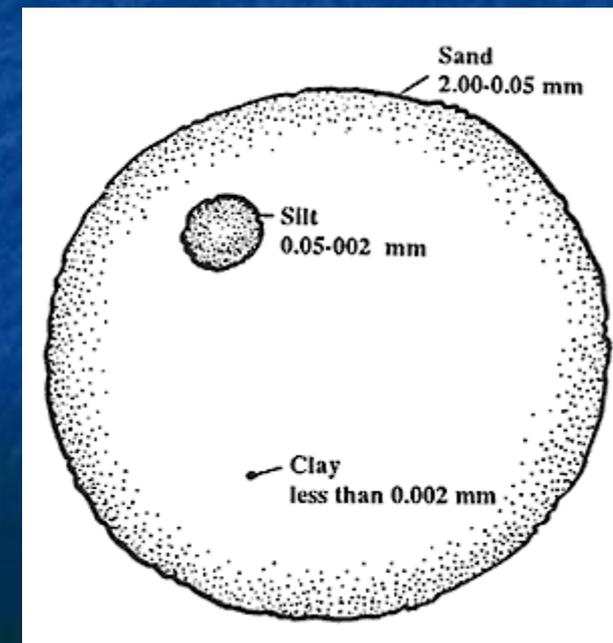
(Properties that describe the soil)

- Color
- Thickness or Depths
- Redox features
- Bedrock
- Texture
- Structure
- Consistence
- Permeability



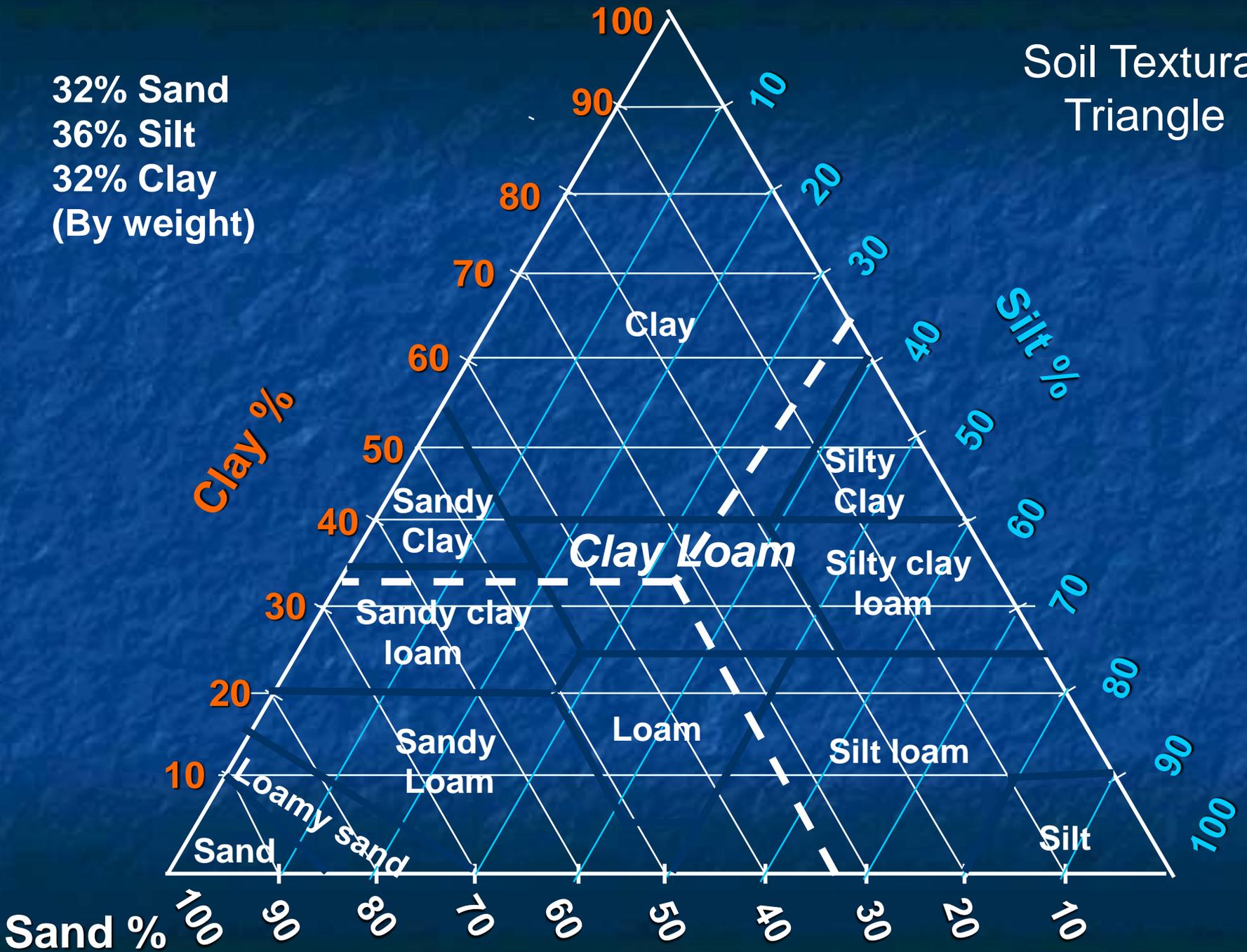
Soil Characteristics: Texture

- Texture-relative proportion of sand, silt, and clay (by weight)
- Sand: 2-0.05mm
- Silt: 0.05-0.002mm
- Clay: <0.002mm

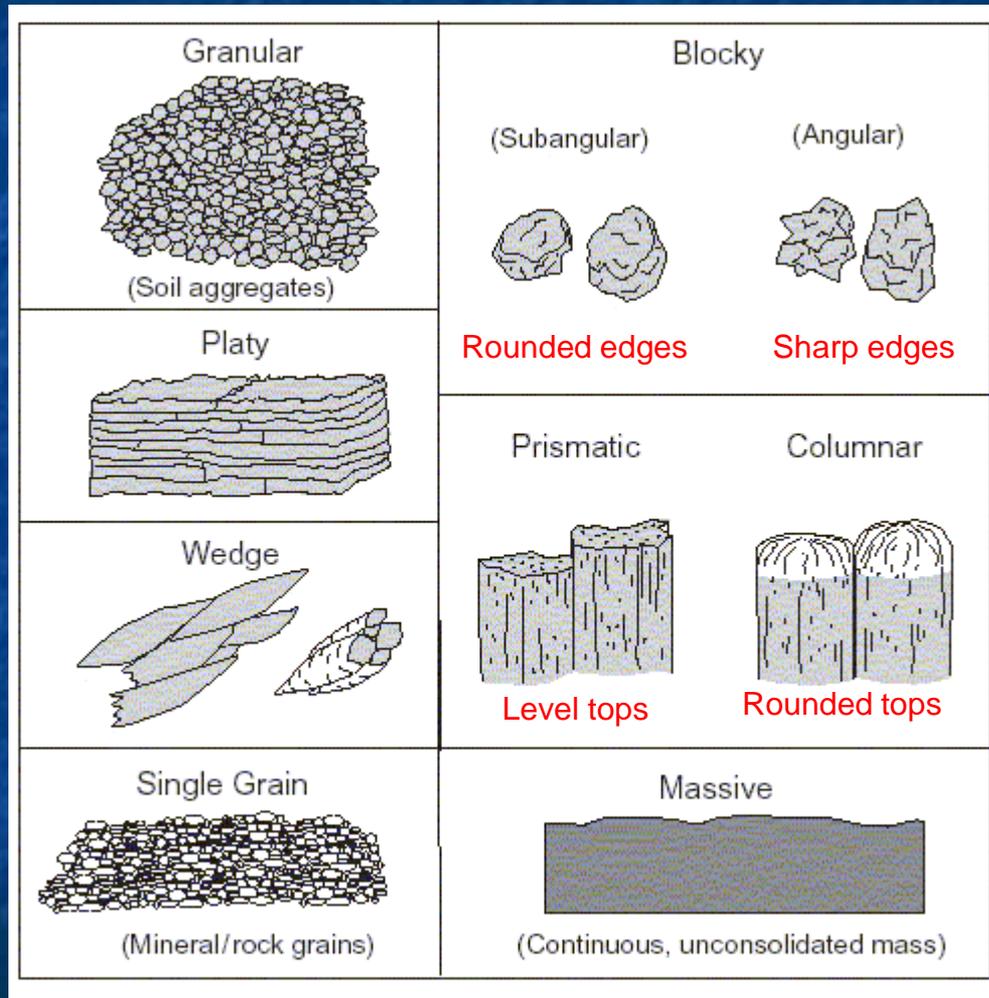


32% Sand
36% Silt
32% Clay
(By weight)

Soil Textural Triangle



Soil Characteristics: Structure



Soil Characteristics: Consistence

“The feel of the soil and the ease with which a lump can be crushed by the fingers”

- ❑ Sticky
- ❑ Hard
- ❑ Soft
- ❑ Loose
- ❑ Cemented
- ❑ Friable
- ❑ Firm
- ❑ Plastic



Soil Characteristics: Permeability

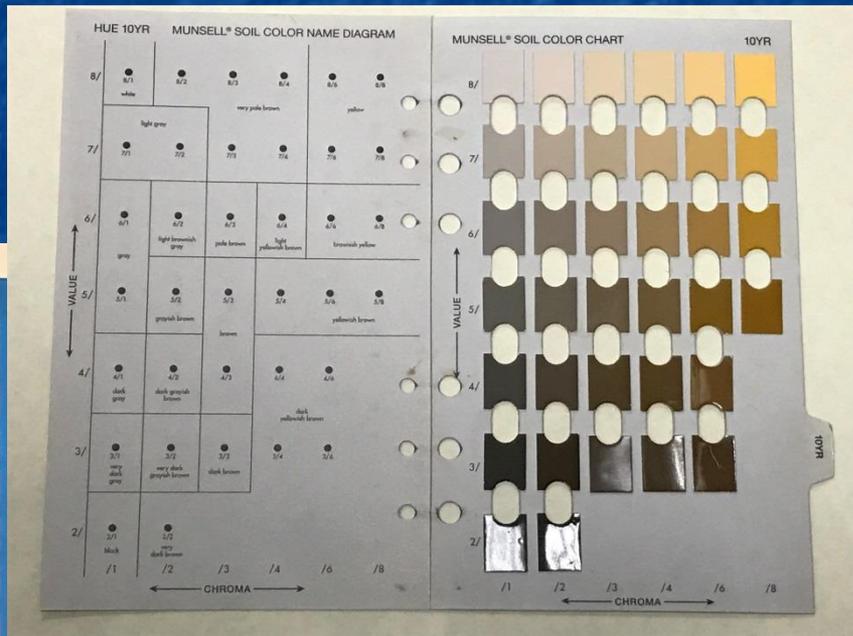
“The ease with which fluids or gasses can flow through the soil profile”



(Inches per hour of water movement downward through saturated soil)

Soil Characteristics: Color

- *Munsell* soil color charts used as a standard worldwide



MUNSELL
SOIL COLOR CHARTS

Soil Characteristics: Color

- Hue: dominant spectral color
- Value: darkness/lightness
- Chroma: relative purity of strength of color

10YR 3/2 = Hue 10YR; Value 3; Chroma 2



Soil Characteristics: Redoximorphic Features

- Mottled soil colors caused by a fluctuating water table



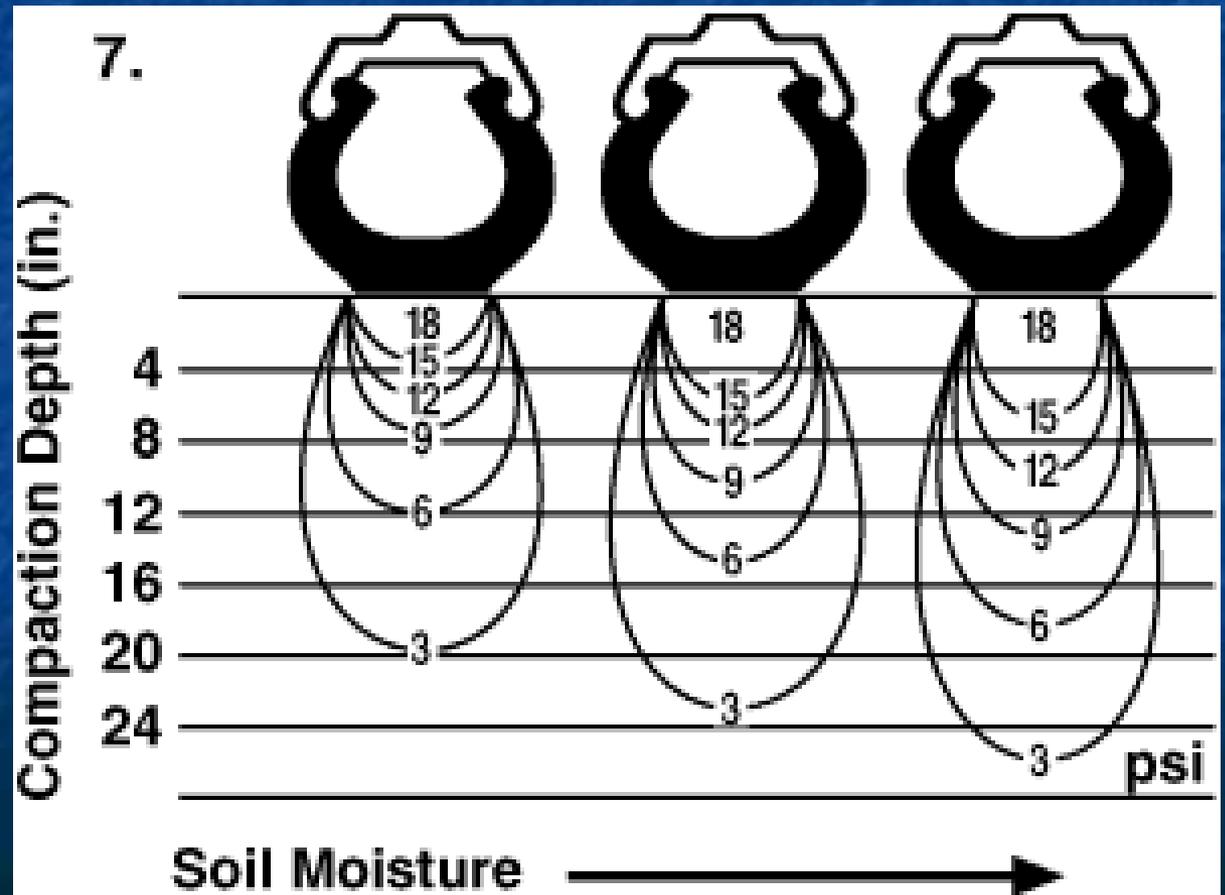
Bulk Density

- Weight of a given volume of dry, undisturbed soil
- Measured in g/cc



Compaction

- The reduction of pore space, increasing the bulk density



Compaction

- Effects:
 - ✓ root growth & development
 - ✓ water & air movement

5 row cotton picker weighs
37,100 lbs empty (18 ½ tons)



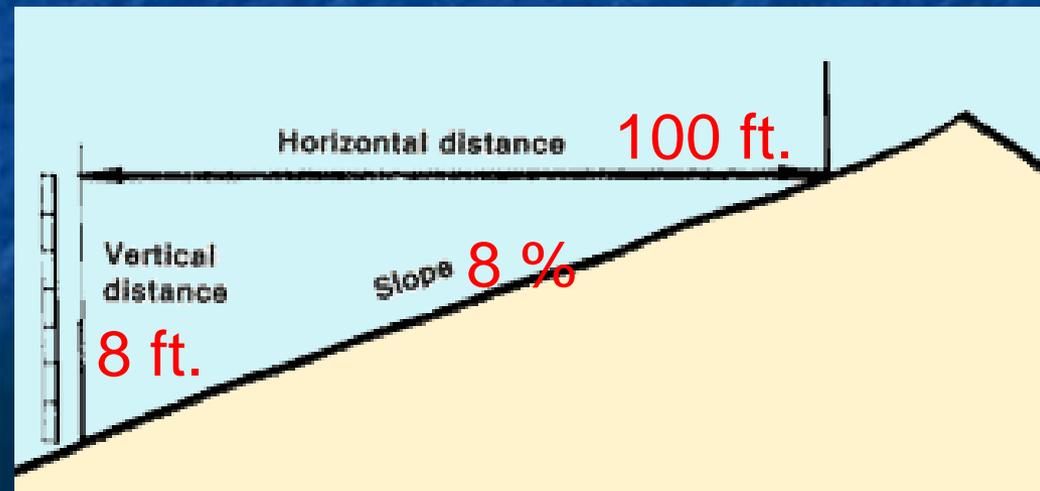
Infiltration

- The process of water entering the soil from the surface
- *(Good infiltration reduces erosion, runoff, and ponding)*



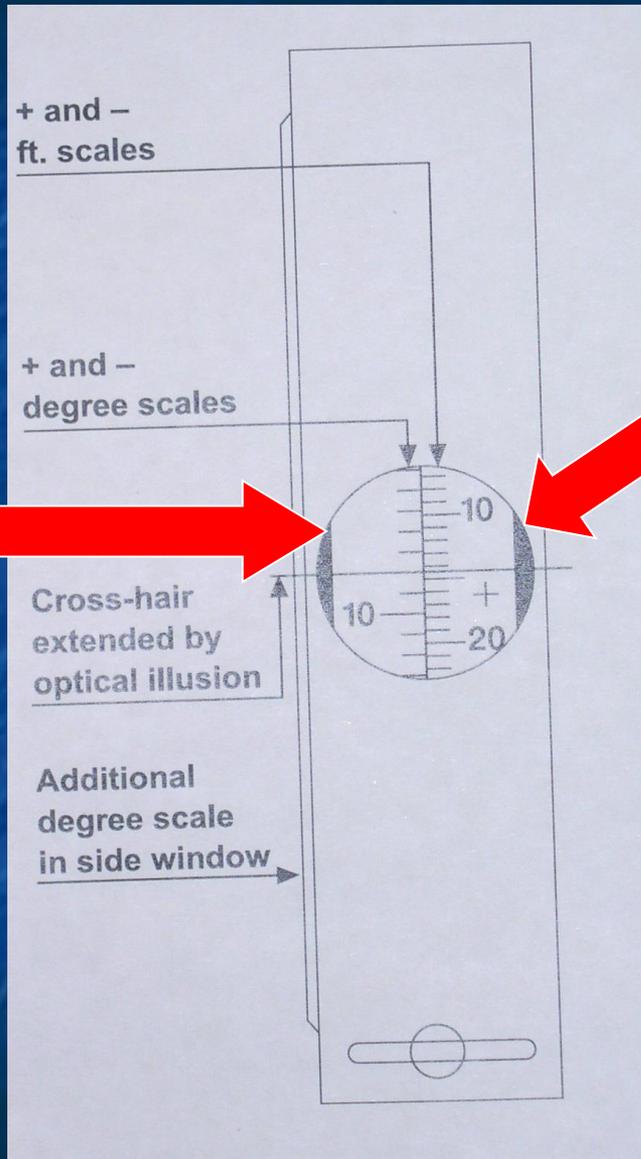
Slope

- The gradient of the soil surface, expressed as a percentage
- A commonly used measuring device for slope is a *clinometer*



Clinometer

degree scale

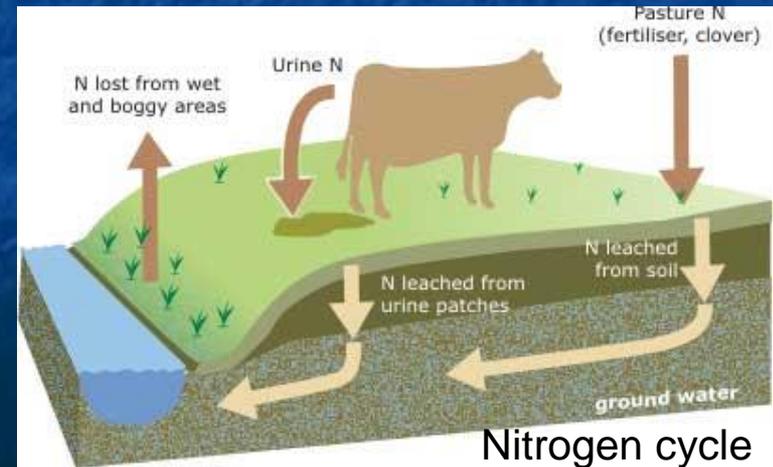


% slope scale

(Soil map units expressed in % slope)

Plant Nutrients

- Soils store and cycle plant nutrients such as **N, P, K, C, S**, and others
- Cation exchange capacity (CEC) is a measure of the quantity of nutrients that a soil can hold
- *> soil organic matter leads to > CEC*



Plant Nutrients:

The effect of pH

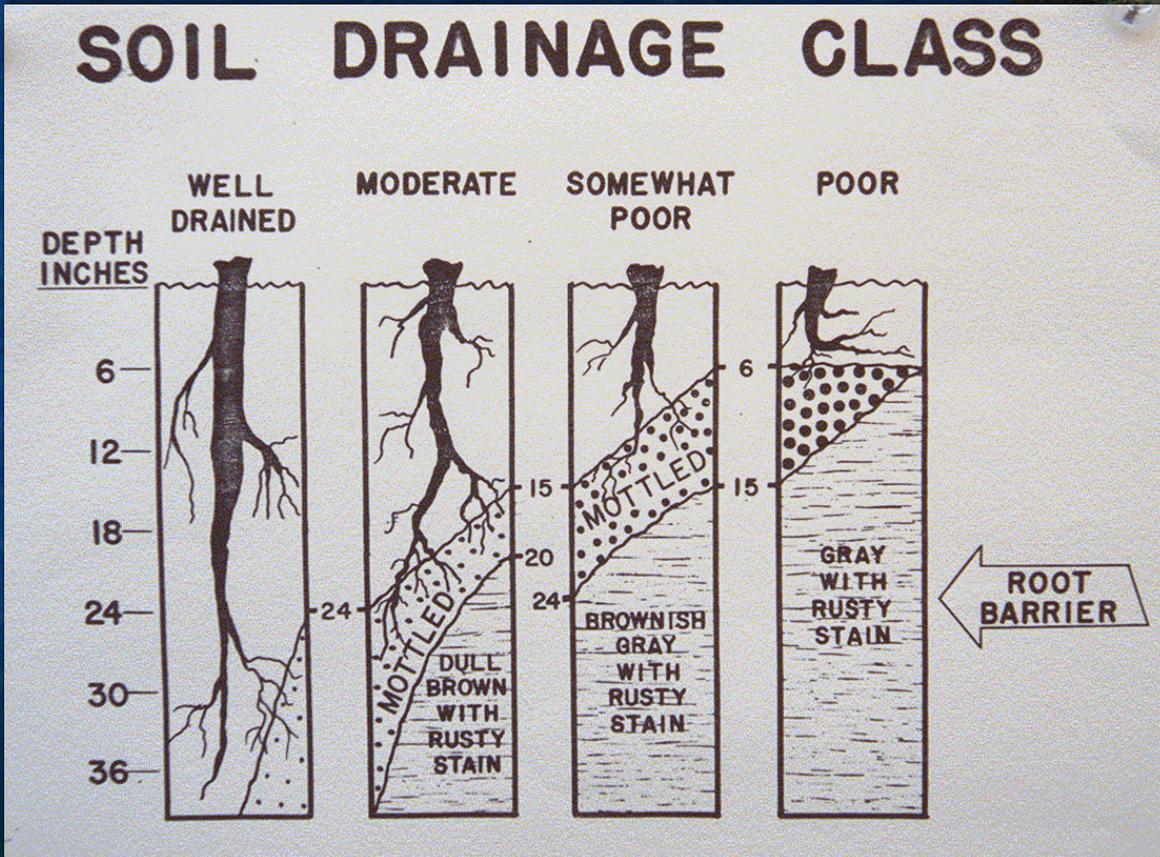
- *pH* = a measure of acidity or alkalinity of a soil
- Optimum pH for plant growth = 6.0 to 7.5
- Plant nutrients may become unavailable outside of this range



Soil Drainage Classes



Windthrow
Allegheny National Forest
Pennsylvania



Hydric Soils

- “a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part”



Wetlands

- Wetlands generally have 3 components:
 1. *hydric* soils
 2. *hydrophytic* vegetation
 3. *saturated hydrology* during a portion of the growing season



Wetlands Easement
Town of Stockton, NY

Soil Water-Terms

FIELD MOISTURE CAPACITY: moisture content of soil after the free water has drained away.

WILTING POINT: moisture content of soil at which a plant wilts so much that it does not recover.



Soil Water-Terms

AVAILABLE WATER CAPACITY:

capacity of soils to hold water available for use by most plants. (inches of water per inch of soil)

Available Water Capacity =

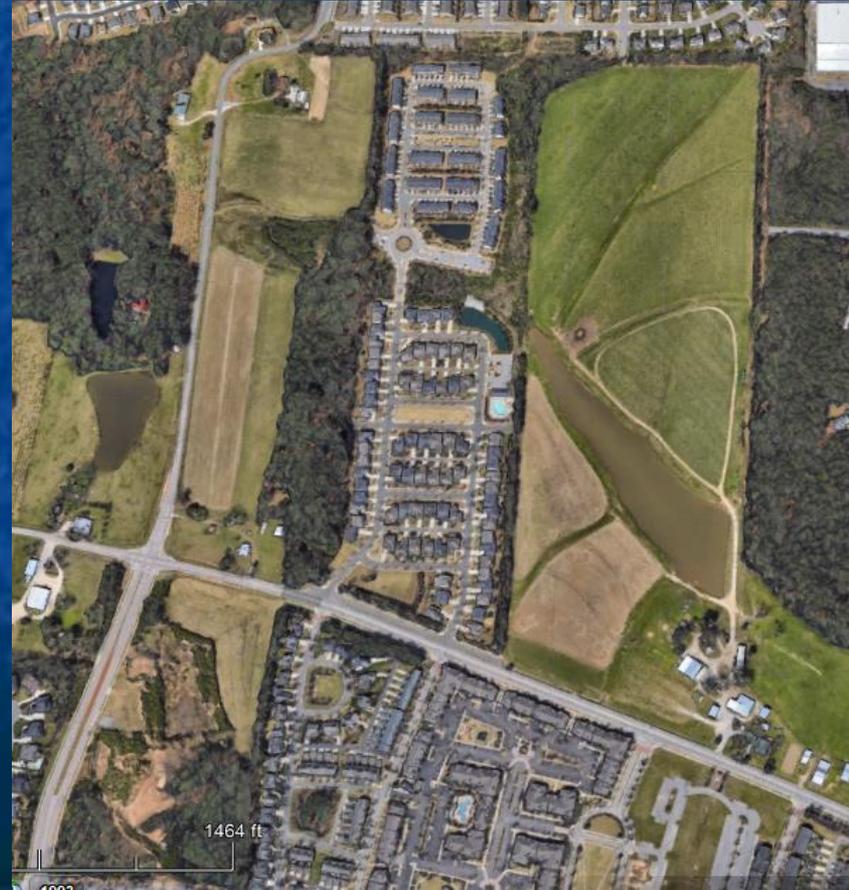
Field Moisture Capacity – Wilting Point

Land Use Affects Soil Productivity



Agricultural practices

Development



Non-Point Source Pollution: *(soils may act as a treatment system)*

Organic & Inorganic
materials



soil

Filters

Detoxifies

Buffers

Immobilizes

Degrades

water table



Courtesy: EPA

Non-Point Source Pollution

- soils may become contaminated beyond their ability to treat pollutants



Non-Point Source Pollution

Soils may become the pollutant



Term: _____?

Soil Erosion

Water



Wind

Soil Erosion:

the Universal Soil Loss Equation

$$A = R \times K \times LS \times C \times P$$

where A = average annual soil loss from sheet & rill erosion in tons per acre per year (by water)

- Later Models: RUSLE2 and Water Erosion Prediction Project (WEPP)
- similar equation exists for *wind* erosion

Universal Soil Loss Equation

- R = Rainfall factor

higher rainfall amounts or intensity
results in higher R factor



Universal Soil Loss Equation

- K = soil erodibility factor
determined by soil texture,
and other properties



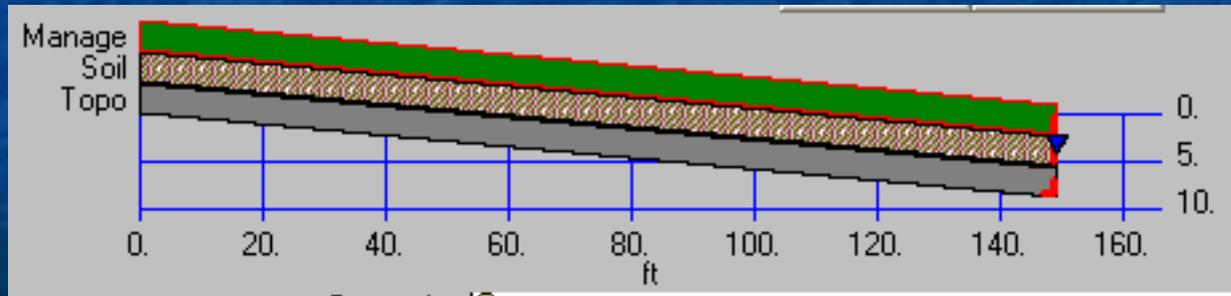
Universal Soil Loss Equation

- L = slope length (feet)

starts where overland flow begins
ends where deposition begins

- S = slope gradient (percent)

average slope over the slope
length



Universal Soil Loss Equation

- C = cover & management factor
crop canopy and residue
protection

“Soil is meant to be covered!”



Universal Soil Loss Equation

- P = support practice factor

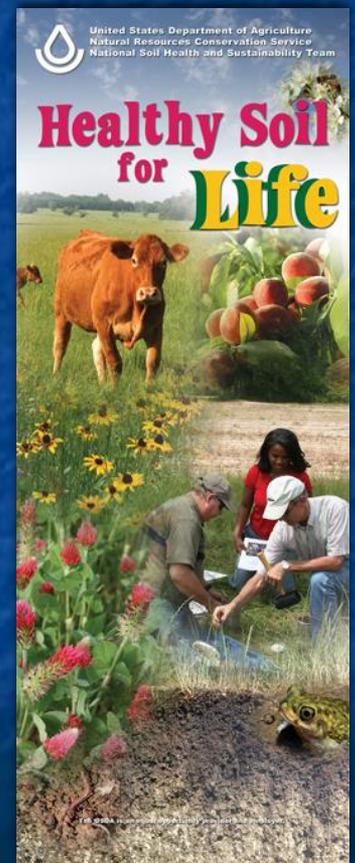
up & down hill tillage vs. contour tillage
(what is wrong with this picture?)



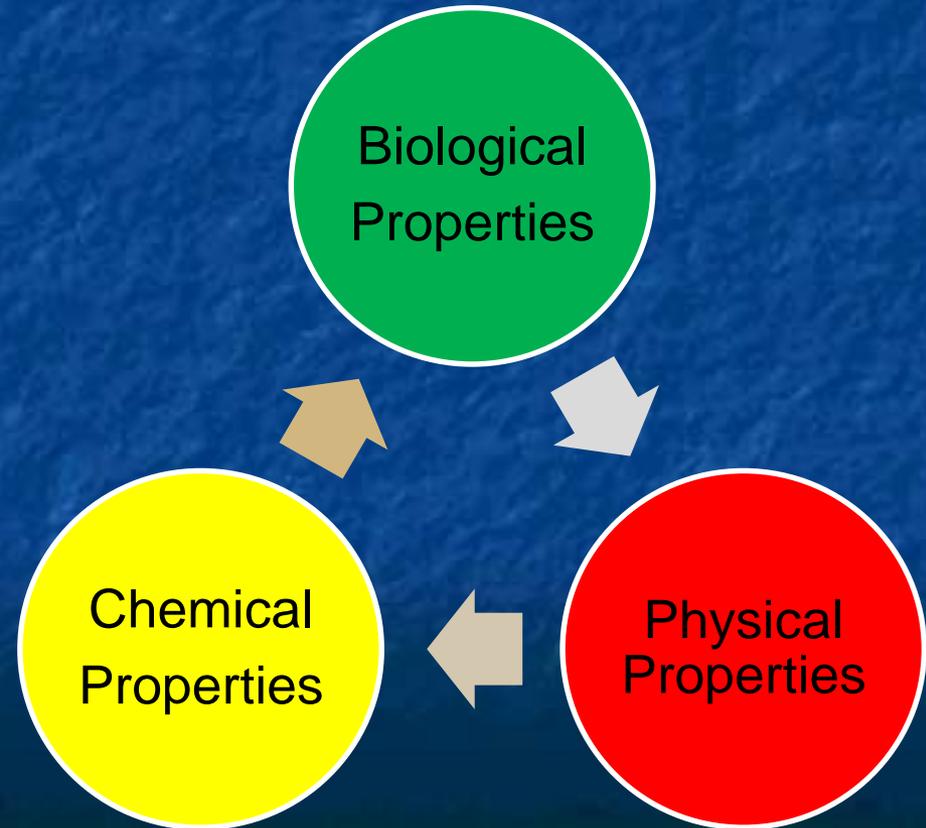
Soil Health

Soil health = soil quality

- *how well soil does what we want it to do:*
 - *sustain plant and animal productivity*
 - *maintain or enhance water and air quality*
 - *support human health and habitation*



Soil Health



Soil Classification

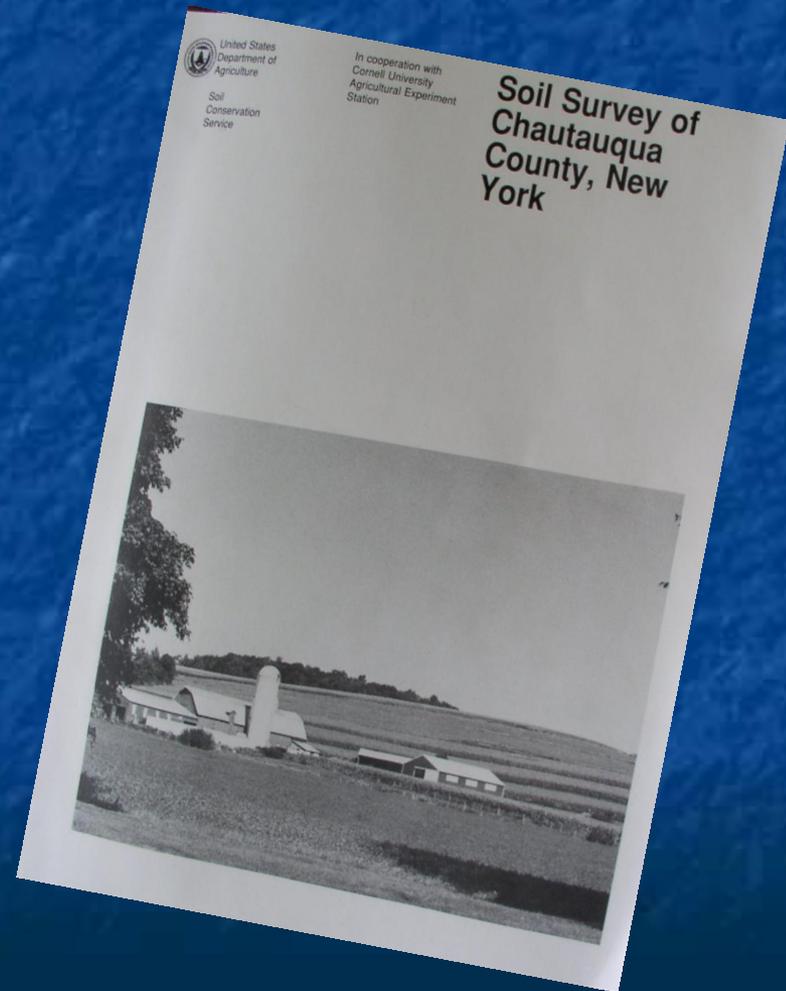
Order	Suborder	Great Group	Subgroup	Family	Series
Inceptisol	Aquept	Haplaquepts	Aeric	Coarse-loamy, mixed, nonacid, mesic	Busti
soils that exhibit minimal horizon development	Aqu=water, ept=Inceptisols	Hapl=minimal horizonation	Aeric=better drained than the typical subgroup	Physical and chemical properties and other characteristics that affect management	Soils with similar horizons in their profile

Reference County Soil Survey pages 171 and 331.

Soil Survey

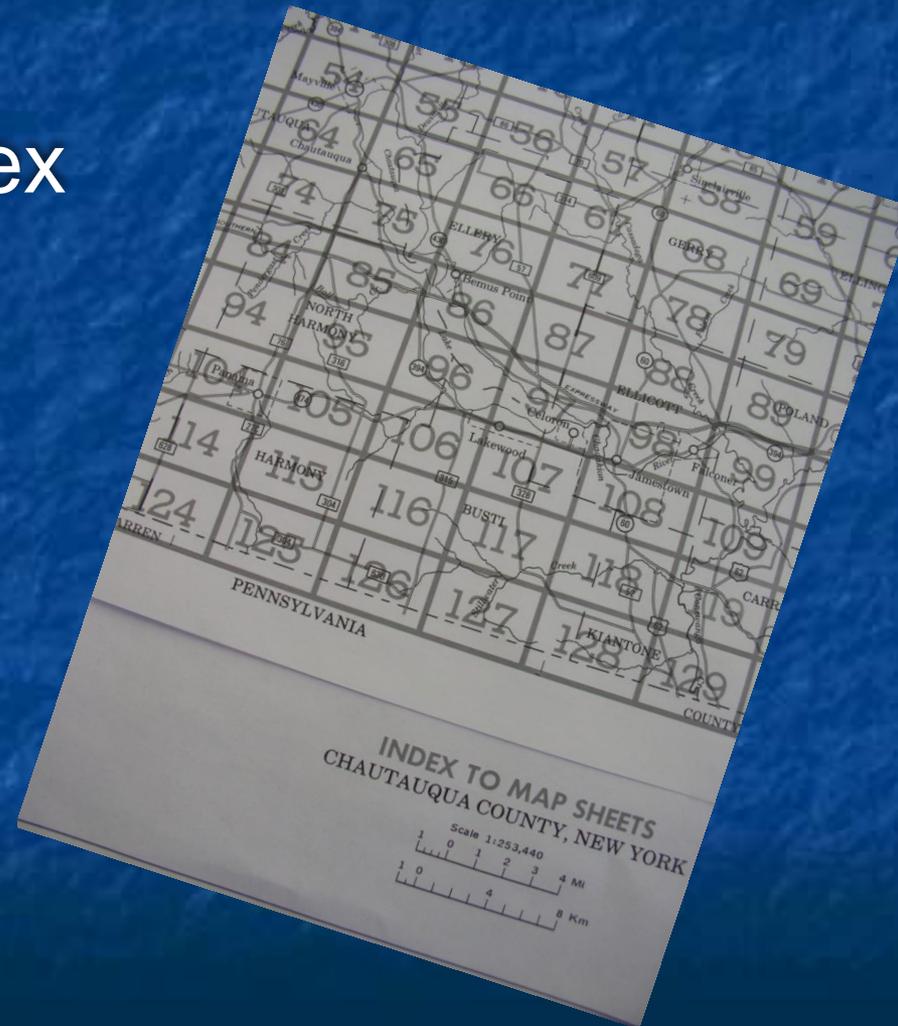
Published survey:

- Mapping & interpretations
- Glossary of terms



Soil Survey

- Map Index



Soil Survey



CkC:
Chautauqua
silt loam
8-15% slopes

*There are 131
different map
units in the
Chautauqua
County
Soil Survey!*

Soil Survey

- Also available online at:

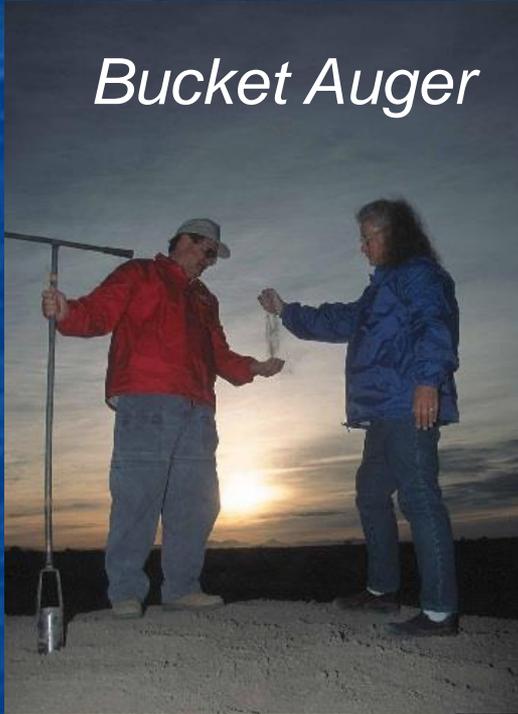
<http://websoilsurvey.nrcs.usda.gov/app/>

The screenshot displays the 'Soil Data Explorer' web application. At the top, a dark red banner contains the text 'Soil Data Explorer'. Below this, the application interface is visible, featuring a navigation menu with 'Soil Data Explorer' highlighted. The main content area is divided into several sections: 'Soil Information by Use' (set to 'Fossiliferous'), 'Soil Properties and Qualities', and 'Map Unit Hybrid Rating'. The 'Map Unit Hybrid Rating' section is active, showing a map of the 'Yamhill Area, Oregon' with various soil units color-coded. A table at the bottom provides a summary of the map unit data.

Map unit symbol	Map unit name	Rating	Acres in B01	Percent of B01
000	Andy silt loam	Partially Hybrid	36.4	3.5%

Soil Sampling Tools

Bucket Auger



Punch Probe



Screw Auger



Resources:

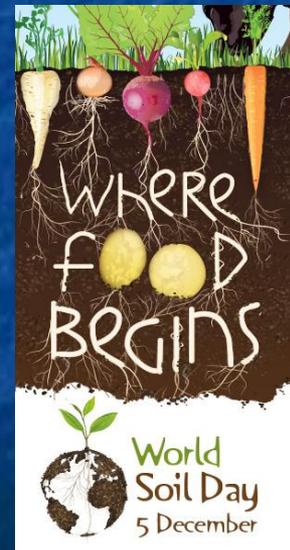
- <http://www.nrcs.usda.gov/>
- <http://websoilsurvey.nrcs.usda.gov/app/>



United States Department of Agriculture
Natural Resources Conservation Service



CHAUTAUQUA COUNTY
SOIL & WATER
CONSERVATION DISTRICT



World Soil Day-2015
UN-FAO



"We know more about the movement
of celestial bodies than about the soil underfoot."
- Leonardo Da Vinci, circa 1500's